Customer No.: 31561
Docket No.: 12468-US-PA
Application No.: 10/709,036

REMARKS

Present Status of the Application

The Office Action remains rejections on claims 1-7. Specifically, claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admitted Prior Art (AAPA) in view of Nishitani et al. (JP02001102323; hereinafter Nishitani) and in view of Elliott et al. (U. S. Pub. 20020069966; hereinafter Claims 1-7 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Discussion of Claim Rejections under 35 USC 103

Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Nishitani and Elliott. Applicants respectfully traverse the rejections for at least the reasons set forth below.

1. As previously mentioned, the claimed invention can simultaneously adjust the laser annealing energy for annealing the amorphous silicon thin film, according to the ***measured resistance of the annealed silicon***, which is changing from amorphous silicon to the polysilicon with varying sheet resistance.

Here, it should be noted that the resistance of annealed amorphous silicon is measured, resulting in a specific mechanism and system structure, based on the resistance change but not based on the optical mechanism as will be discussed below.

2. The Office Action newly cites Nishitani and Elliott in combination with AAPA, in which

Nishitani is used as the disclosure for feedback control in real-time.

Applicants respectfully state that Nishitani does not disclose the mechanism based on measuring resistance as recited Claim 1, resulting in structural difference.

Clearly, Nishitani (i.e Abstract; [0033], [0034], [0041], [0045], [0049 - 0050], [0055 - 0057], [0082 - 0084]) is based on monitoring the varying of beam intensity of a constant ratio of the returning laser beam from the amorphous silicon by the power monitor 15 (16). Due to the crystallization status, the measured beam intensity from the mirror 14 will change as shown in Fig. 4 and Fig. 6. The power monitor 15 measures the fluctuation of the laser intensity from 14. Further, [0057] discloses that the laser intensity measurement is the employed mechanism for automatically adjusting the exposure energy density. Therefore, Nishitani is based on different mechanism (not based on resistance change of the present invention) and results in different system structure.

3. In comparing the present invention with Nishitani, features of the present invention at least includes that (1) the resistance of annealed amorphous-Si into polysilicon is monitored; and (2) the laser beam is controlled or adjusted according to the results of measurement from (1). However, Nishitani measures the laser fluctuation due to the crystallization status of the Si substrate.

The different mechanism results in different structure. In addition, some nonobvious unexpected results can be achieved by the present invention. The present invention adjusts the laser energy density based on the measurement of resistance for the annealed amorphous silicon.

The monitor accuracy is a total performance and is not easily affected.

However, Nishitani in optical mechanism may be affected by detecting window and detector contamination, such as deposition contamination. The present invention is more realistic.

	The present oinvention	Nishitani
Monitoring method	Sheet resistance of annealed silicon (polysilicon)	[0005]Laser beam intensity and profile
Monitoring (measurement tool)	resistance measurement module	[0033][0034]Laser power monitor (pyrometer photo diode etc.) and [0082]beam profiler
Feed back to	laser generation module	[0049]attenuator [0076][0077] laser voltage (HV)

In conclusion, Nishitani discloses an optical monitoring mechanism and does not specifically teach or suggest the measurement of the sheet resistance for monitoring the annealing status of the annealed amorphous silicon into polysilicon.

4. AAPA and Elliott do not disclose the above features of the present invention, either.

For at least the foregoing reasons, Applicants respectfully submit that independent claim 1 patently defines over the prior art references, and should be allowed. For at least the same reasons, dependent claims 2-7 patently define over the prior art references as well.

Customer No.: 31561
Docket No.: 12468-US-PA
Application No.: 10/709,036

CONCLUSION

For at least the foregoing reasons, it is believed that all the pending claims 1-7 of the invention patently define over the prior art and are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully Submitted,

Date : June 12, 2007

Belinda Lee
Registration No.: 46,863

Jianq Chyun Intellectual Property Office
7th Floor-1, No. 100
Roosevelt Road, Section 2
Taipei, 100
Taiwan
Tel: 011-886-2-2369-2800
Fax: 011-886-2-2369-7233
Email: belinda@jcipgroup.com.tw
Usa@jcipgroup.com.tw

APPENDIX:JP2001-102323 p.1

English

[0033] In the following embodiment, laser power is measured by some kind of power monitor. At that time it should be noted that laser power is measured after enough irradiating laser light to power monitor, because measurement value is variable until power monitor is stabilized thermally. And when preheating time cannot be enough, by measuring with short preheating time, for example defined 30 sec, (measurement result) shows slightly low value but comparatively stable measurement can be achieved. This measurement methods of power monitor should be used in similar way for power measurement by power monitor in this patent.

[0034]Power monitor is for measurement of light quantity and in this patent, pyrometer is mainly used but the other kind of power monitor also can be used.

[0041] In the laser annealing machine, several shuttle (return) mirrors are used to reduce foot print. The laser annealing machine in this invention (Fig.3), the mirror 14 to return laser light, having pre-determined fraction transmittance of laser light intensity is used and power monitor 15 to measure laser light intensity transmitted trough this mirror. By this method, laser intensity fluctuation can be measured for actual substrate during irradiating

[0049] Laser annealing machine(Fig.2) is same with embodiment 1, laser light 5 irradiated from laser main body 2, expose to substrate 12 trough light attenuator 4, light uniform device 6, laser shaping optical, and incident chamber window. Laser annealing machine of this invention (Fig.5) has laser light intensity measurement system (power monitor) 16 in the chamber 10. Fig 6 shows measurement value of power monitor 16 after exposing for long time. Error of power monitor is about 1.5 % , so when average measurement value of power monitor for 1 min. is over 2% from setting value, laser annealing is performed with readjustment to get setting irradiation value.

[0050] In the prior art (Fig.2) the shift value of laser intensity at substrate position from setting value is about 9%. By using the system of this embodiment (Fig.5), the shift value of laser intensity from setting value is reduced less than 3%. Fig. 5 shows the graph of measurement value of power monitor 16 after exposing for long time. The sheet-to-sheet stability (variation) of fabricated poly single film characteristic is improve 10cm2/Vs from previous

[0055] Laser annealing machine in this invention have the window to pick up laser light incident to chamber 10 outside from the chamber. Measurement laser light intensity system (power monitor) is set at the position where laser light is passed through chamber. Error of power monitor is about 0.5-1.5 % , so when average measurement value of power monitor for 1 min. is over 1% from setting value, laser annealing is performed with adjustment the angle of light attenuator to get setting irradiation value.

[0056] In the prior art (Fig.2) the shift value of laser intensity at substrate position from setting value is supposed about 9%. By using the system of this embodiment (Fig.7), the shift of laser intensity from setting value is reduced less than 2.5%. The sheet-to-sheet stability (variation) of fabricated poly single film characteristic is improve 9cm2/Vs from previous 21cm2/Vs. And using above laser intensity measurement system, adjustment of light attenuating plate angle is automated. Using the light attenuating plate that transmittance is increased with increasing angle of the light attenuating plate, when measurement laser intensity is larger than settingb valu, that angle is increased and when measurement laser intensity is smaller than setting value, that angle is decreased. And that angle adjustment vlaue is varied with magnitude of shift between measurement laser intensity and setting value. With automatic laser intensity adjustment, adjustment of exposure energy density can be performed quickly. And it's excluded uncertain factor by human operation and judgement and reduced shift of the laser light energy density from setting value. It took 2 min. for exposure intensity adjustment before but by installation of this automatic adjustment, it's reduced to 30 sec. and total tact time (processingb time for 1 sheet) is

[0082] And the machine in the prior art, measurement device for the spacing distribution of laser light 23 (beam profiler) is setting at the front of chamber window and beam profiler is measured with 15Hz even laser light expose with high frequency for example 300Hz.

[0083] One example of the machine for this embodgiment is shown in Fig. 11 and 12. Laser annealing machine of this embodiment has following features.

[0084] 1) profile measurement system 23 is located at propriety position. for example, it's located the position where laser light pick up to outside, that laser light incident in the chamber 10 or chamber inside. By this method, variation of the chamber window transmittance or transmittance distribution can be monitored. And with setting the beam profiler at the same height and same position with upper side of the substrate of chamber inside, more exact beam profile can be achieved (Fig.11).